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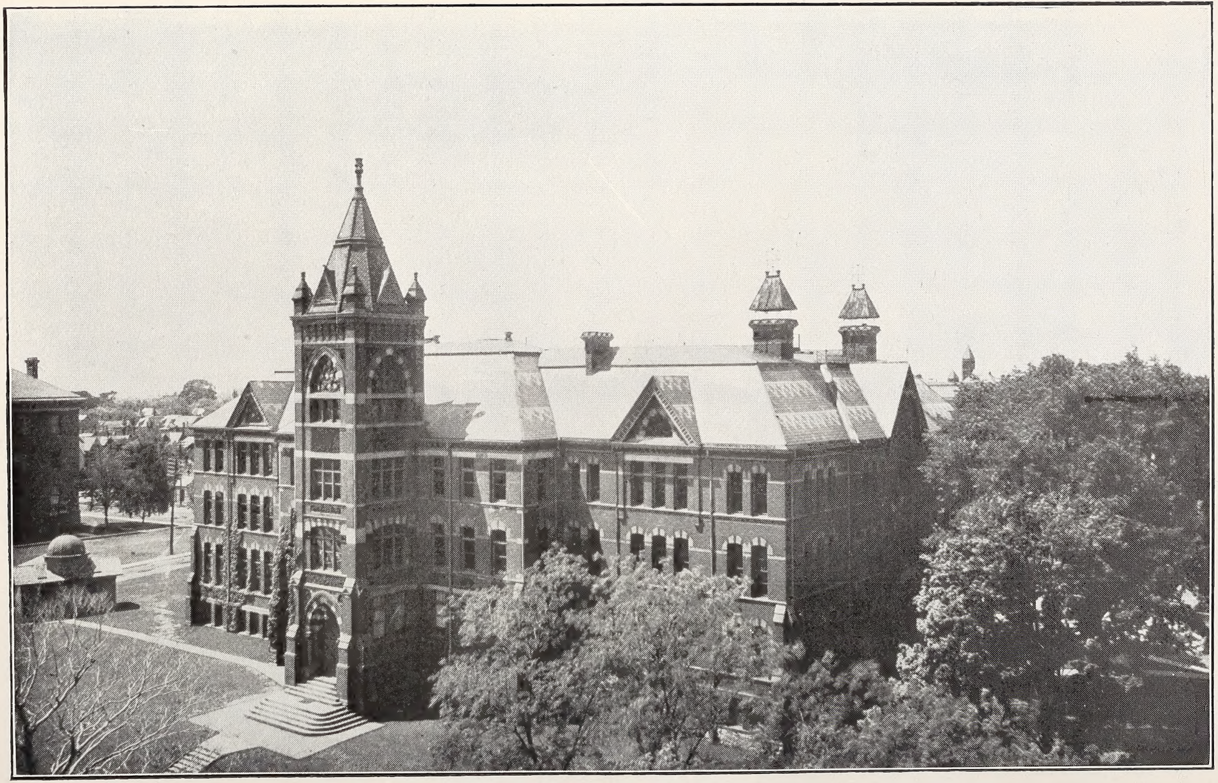


ENGINEERING BUILDING, UNIVERSITY OF TORONTO
The old school which must soon be replaced by a larger and more modern structure

Applied Science

INCORPORATED WITH

TRANSACTIONS OF THE UNIVERSITY OF TORONTO ENGINEERING SOCIETY

Old Series Vol. 22 FEBRUARY, 1909 New Series Vol. 2, No. 4

APPLIED SCIENCE DINNER.

A. D. LePAN, B.A., Sc.

On the evening of Friday, Jan. 31st, 1890, the first annual dinner of the Engineering Society of the then School of Practical Science was held at the Hub where, in all, 54, including guests, Faculty, graduates and undergraduates, formed a company who though optimistic to the fullest degree, little dreamed to just what proportions this little affair might grow.

Twenty years later some of the same men and a "few" others sat down to another dinner held by the same Society of the now Faculty of Applied Science of the University of Toronto. Before going further some may ask: why speak of the dinner of 1909; for every graduate or undergraduate attended it or should have attended it, and to those who did, every event of that evening is and will remain for many years as clear as at the time of happening. In a large measure this is true, but still there are those who were unable to be present, though perhaps deeply interested in the Society, and to these and to posterity we owe some record of one of the evidences of the admission of this Faculty to its proper place in the University and of its immeasurable influence, wielded through its graduates, in every phase of national life.

Many circumstances this year tended to make this the largest dinner and most noteworthy social function ever held in connection with Applied Science in the University of Toronto. First, there is that exuberant and deeply rooted spirit of loyalty which every School man bears to his University as evidenced by his attitude towards his Alma Mater, its Faculty and all associations connected with them. In the days of the "Ink" age this spirit was manifest in the readiness and eagerness with which he cultivated his artistic sense at the expense of his opponents, but to-day, through assimilation, this much abused fluid of other days flows through saner channels tracing on its course an indelible record of growth substantial and lasting, of appreciation genuine and sincere and of acknowledgment of our greater responsibility and privileges through this growth.

Then, too, the Canadian Society of Civil Engineers met in

Toronto and the Engineering Society was fortunate in having as its guests 200 of the members of this sister society. The circumstance was all the more auspicious since Dr. Galbraith, as President of C.S.C.E., delivered on the evening of the dinner, his valedictory address dealing, in masterly detail, with engineering problems of to-day; and in no small measure was this dinner intended as a personal tribute to Dean Galbraith and Dr. Ellis, two of the charter members of this Society who through years of faithful and untiring service have endeared themselves to each succeeding graduating class. Considering all these facts, it is little wonder that the advent of the School dinner was eagerly looked forward to on all sides.

As early as 7.30 intending diners commenced to arrive, those of older years to be present at the Canadian Society meeting, and the more frivolous youth to roam the corridors which first resounded with his clear and blithesome "Toike Oike" and later with his almost agonized appeal for dinner, for, in the excitement, caused by the change from the short blue jumper, which now hangs in the laboratory, now forms a missile intended for some industrious embryo engineer and now as a duster for the School boilers as its prisoner blinkingly treads these oft-explored passages, to the silk lined flowing garment, emblem of social pleasure and obligation, many an expectant youth had forgotten the commoner things of life and now awaited the opportunity of presenting himself at the festive board for the third time that day, or possibly the second for to many breakfast is often "run fast" from bed to lecture. Under these circumstances it is recognizable that when the doors of the banquet hall were opened at 9 p.m. and the guests and more privileged persons had gained admission, that some slight anxiety might be manifest on the part of the undergraduate body to satisfy the natural demands of the inner man. Evidence of this was obtained, if in no other way, from the over-turning of a row of chairs in Convocation Hall and the releasing of a door from its normal position in spite of the efforts of the genial Christie and our own "Jock," but soon the good-natured crowd were all in the banquet hall with the exception of about 40 who for lack of accommodation were forced to sit down in the tiled corridors of Convocation Hall.

The drafting-room transformed into a banquet hall could hardly be recognized by the embryonic engineers who strugggle in vain to keep the dread "See Copy" off their alleged works of art and engineering skill, for in the place of solid rows of sombre work tables, the room is filled with long tables draped for the present in spotless white and decked with a profusion of flowers rarely seen by the engineer who with long boots and almost longer whiskers tramps the wilderness, drawing imaginary lines, or who, with grimy hands seeks to solve the mysteries of the invisible and illusive "'current." Extending the full length of the hall we have the guests' table and on the wall over its centre a huge shield of welcome draped with a profusion of flags.

Directly opposite on the other wall we see amid a mass of flags and bunting, a portrait of Dean Galbraith. But this transformation did not in the least seem to perturb any of those present and soon with amazing rapidity all were invited to partake of a menu "I am part of all that I have met" which diverted the attention of even the most aesthetically inclined to the baser yet essential things of life. During the serving of an excellent repast the sense of humor of the man, who had not partaken of the necessaries of life since his regular noon-day struggle with a so-called sirloin or his perhaps indelicate queries as to the contents of the indeterminate Hamburg steak, began to rise; much hilarity was indulged in and as the meal progressed these individuals accepted with the utmost grace their ice-cream as a filler between the reverse side of a plate and the erstwhile spotless linen.

But all pleasures must end and this as others did, only to be succeeded by pleasures of different forms, for with the tables cleared and with the man who believes it is better to smoke here than hereafter indulging, President Marshall, chairman of the evening, proposed the toast to the King. He then introduced a second toast of the evening—"Canada" and connected with its proposal A. D. LePan who, in a brief speech, dealt with the comparisons between the past and present in the engineering history of this country, the transportation problems and possibilities of increased activity along engineering lines as evidenced by the prevailing excellent financial conditions, and introduced in reply Byron E. Walker, Esq., as "A man who fingers with a touch, perhaps the most sensitive in Canada to-day, the throbbing pulse of Canadian life and conditions."

In rising to reply, Mr. Walker was enthusiastically received, and immediately won the closest attention and interest of his hearers. He outlined with vigor his belief that the young men of to-day, and especially the engineers, should study as well as development, a conservation of Canada's resources from the grasping need of a world which is rapidly becoming poor in the very iron, timber and other treasures of which Canada has such stores.

"A great trust has fallen upon you young gentlemen," said the speaker. "Do not be proud of Canada because you are Candians, but because the trust falls upon you to develop and conserve our wealth. We and you shall be judged some day by the use we make of it. We in Canada are in great danger to-day. No other country of only 7,500,000 people has such great resources and has at the same time lying to the south the most profligate user of natural resources in the world and one which to-day has practically exhausted all that it once possessed. Our problem to-day is not to develop Canada's wealth, but to conserve it. If it be true that in a comparatively few years the iron and timber of the United States will be exhausted, do you think that when that time comes we shall be allowed to enjoy our own resources at our leisure? The United States will turn like lightning upon them and devour them as fast as it can. So I say learn to conserve what we own. If we do in future centuries Canada will be master of the steel trade and rich in lumber and water powers. All the nations will have to come to her. If you do not, if you cannot awaken your own consciences and the conscience of the public to the menace of our timber, our water ways, our fisheries, and our farm land which lie in the demands of a profligate age, you will have occasion to glory in being cowards. You will have been false to your trust."

The deep interest with which these remarks were received showed that the speaker had indeed struck a responsive chord in all his hearers and had impressed them not only with the glorious heritage which is ours, but also with the responsibilities which ownership of this trust involves and with the fact that conservation should not be sacrificed to development.

In proposing the toast to the University W. B. Redfern, '08, in an excellent speech, eulogistic of President Falconer, said in part:

"Speaking on behalf of the undergraduates, the graduates, and I believe on behalf of every member of the staff as one Faculty among several others in this great University, we hope that we may all be so harmonized and blended in spirit and aim, that the day is past when it was natural for one Faculty to work in isolation and aloofness and that instead even over past prejudice, past jealousy and past traditions we may have an interchange going on in increasing measure, an interchange that helps him who gives and him who takes, an interchange in which each Faculty is the gainer, in this way making our University truly one integral and unanimous whole.

"The interests of education are in these days so closely bound together that a gain anywhere is a gain everywhere and the feeling which unites universities in all parts of the world by common interest in the advancement and dissemination of knowledge is growing stronger year by year. As one university in the great sisterhood of universities in Canada, we hope that we may all be so refined in spirit and aim, that we may be the embodiment of an ideal which will eventually give to this young and fair dominion the noblest and truest type of citizenship and that it may truly be said of us that we are discharging our duties and measuring up to our responsibilities, in other words, gentlemen, if weighed in the balance, we hope we shall not be found wanting."

From the reception tendered to President Falconer, who replied to this toast, there can be no doubt as to the respect and esteem with which he is held by the graduates and undergraduates of the University of Toronto. Cheer after cheer greeted the speaker and it was only to sing the parody

F-A-L-C-O-N-E-R-!
That's the way you spell his name,
Astray you can't go far,
When you hear it,
How we'll cheer it,
Everywhere we are.
F-A-L-C-O-N-E-R-!

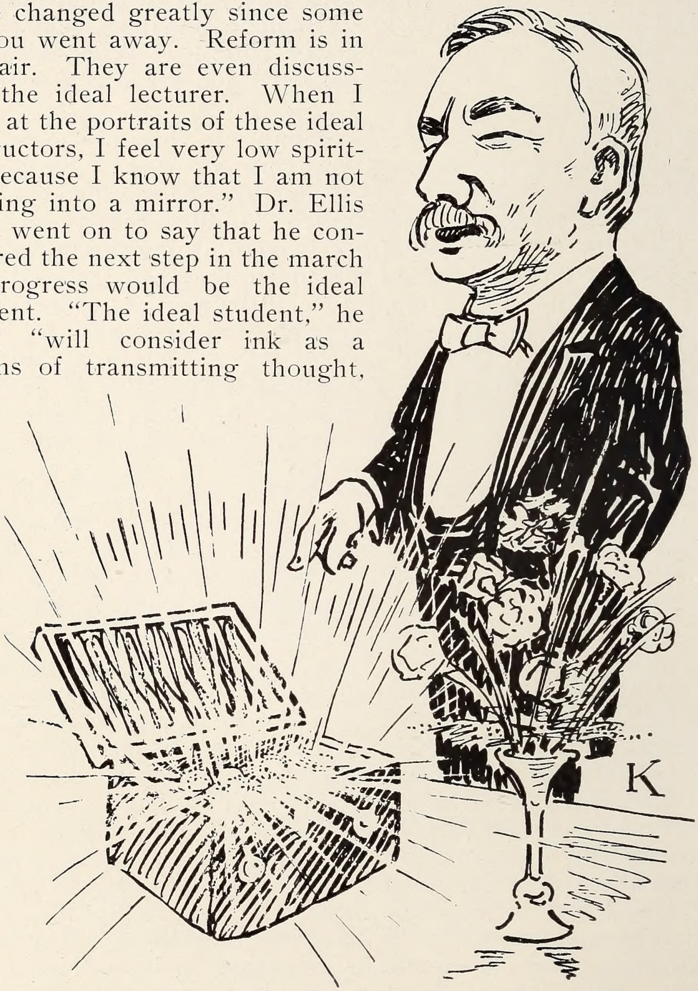
flashed on the screen that anyone desisted. It is fortunate that such demonstrations do occur for there are times when in a moment of thoughtlessness the action of the undergraduates belies his thoughts and respect apparently finds no place in the category of his attainments. But this reception rang true and clear and was indeed a tribute to the man who by his fairness, his masterly control and scholarly attainments has in so short a time endeared himself to the University of Toronto. After this spontaneous reception, President Falconer's address was listened to with rapt attention.

President Falconer has since coming to Toronto shown himself to be one of the happiest speakers we have. He always speaks briefly and he always has something to say that his hearers go away determined to remember. On this occasion he spoke with his usual brevity and impressiveness urging the undergraduates present to bear in mind the advice they had received from Dean Galbraith, that the importance of the man has to be considered as well as that of the engineer and that self-control is absolutely necessary. He told of crossing the ocean a couple of years ago and of observing the splendid discipline of the ship under a cheerful and observant captain with whom he had several pleasant conversations. In the management of that ship every man played his part all under the direction of this one quiet and competent man. "The master of that vessel," he said, "was Captain Sealby who showed the world the other day the strength that self-control gives a man over himself and others." President Falconer, on behalf of the university, extended a warm welcome to all the graduates, the majority of whom he had never seen, as they received their degrees before his term of office began.

Then followed one of the most pleasant events of the whole evening, the chairman intimated that Mr. J. L. Morris, the first graduate of the School of Practical Science was present and that gentleman after dealing in interesting comparisons between the School of the past and present noted that through all this growth and transformation could be seen the guiding hand of men who even in his days had labored unselfishly under most adverse conditions that their ideal might be realized. It was indeed gratifying that these men should see their most optimistic hopes fulfilled and fitting it was that those who had received so much through personal contact with these men and through the realization of their ambitions should be privileged to show their appreciation. When he presented to Dean Galbraith on behalf of the graduates in Science, a cabinet of silver, enthusiasm knew no bounds. When the chorus of "He's a Jolly Good Fellow" and "What's the matter with Johnnie?" "He's all right" died away, Dean Galbraith feelingly thanked the graduates, modestly associating with the success of the School many able assistants who had worked with him on the staff.

In a happy speech of eulogistic reference, Mr. J. W. Tyrrell, of the class of '84, presented to Dr. Ellis a beautiful gold watch and chain, also on behalf of the graduates. Again enthusiasm arose to the extreme, and Dr. Ellis did not belie the chorus "See him smiling."

"I never saw so many of you together before," said Dr. Ellis, when he arose to speak. "Things have changed greatly since some of you went away. Reform is in the air. They are even discussing the ideal lecturer. When I look at the portraits of these ideal instructors, I feel very low spirited because I know that I am not looking into a mirror." Dr. Ellis then went on to say that he considered the next step in the march of progress would be the ideal student. "The ideal student," he said, "will consider ink as a means of transmitting thought,



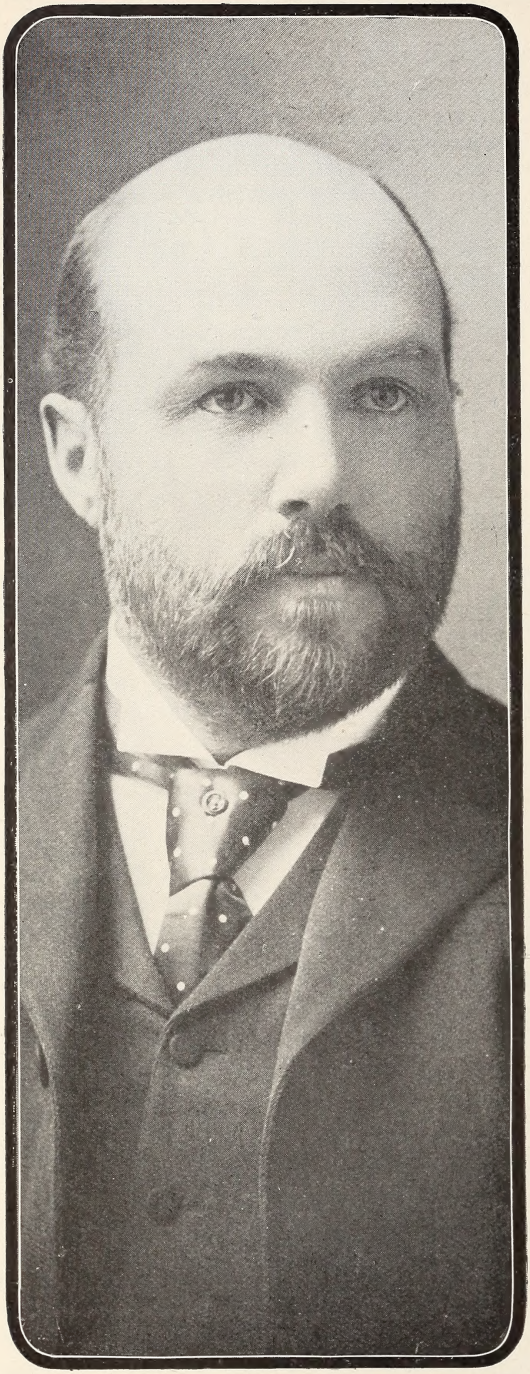
Dean Galbraith was presented with a cabinet of Silver not as an agent for decorating his fellow beings, he will look upon snow as a wonderful form of water rather than a missile. His taste for music will be so cultivated that he will not convert the furniture of the lecture room into sounding brass and tinkling cymbal." The speaker then turned the drift of his conversation in his usual happy manner, "but I find that that student is already here," he said. "He is the man who goes out and wins fame and riches in his profession and then comes back and gives most of the credit to his old teachers."

After the presentations the spirits of the audience were raised to such a pitch that they felt it necessary to have a song from Hugh Ritchie. Accordingly the big fellow, in spite of his struggles, was hoisted on a table and kept there until he rendered three stanzas of "Stop your tickling, Jock," in the most approved style to the great delight of all present.

The chairman then called on P. R. Brecken, '08, to propose the toast to "Our Guests." He spoke of the privileges of entertaining such distinguished guests as the Members of the Canadian Society of Civil Engineers, and of the intimate relation of the Engineering Society as a feeder to the more mature Society. The importance of the engineer in moulding the destinies of this country was emphasized, for on him as much as on the financier depends the support accorded by the investing public. Upon his good judgment and ability are often dependent the lives of hundreds of human beings, not to mention the safeguarding of thousands of dollars. In the matter of reports he must be a man whose one idea is to serve in the most efficient manner or he will often be influenced to make his power subservient to the selfish interests of the few.

Mr. George A. Mountain, Chief Engineer of the G.T.P. and President-elect of the C.S.C.E., in reply, referred to the development in the profession and emphasized the importance of maintaining that high standard so essential in the varied interests of engineering. He also referred to the gratifying growth of the Society and spoke in optimistic terms of its future.

Mr. Kennard Thomson, one of the founders of the Engineering Society, introduced by the chairman as a Scotchman, spoke very happly about the growth of the School and the pleasure that visits of a nature such as this afforded the older graduates. He spoke briefly of the formation of the Engineering Society and stated how utterly impossible it would have been to have formed a Society "but for the encouragement and guiding hand of that incomparable man, Dean Galbraith." He also spoke in a highly complimentary vein in regard to the work of Dean Galbraith on the Bridge Commission and deplored the fact that in New York for some of the investigations then under way, commissions of such a calibre had not been appointed. As a School man, now resident in New York, he spoke in no uncertain terms of the esteem in which our engineers are held and the reception accorded to Canadian engineers who decided to desert their native land



Geo. A. Mountain, C.E.
President Elect Canadian Society Civil Engineers
Courtesy of "Construction."

and cast in their fortunes with those of the neighboring Republic. "Another reason why Canadians are liked in the States is because they are always loyal to the land of their birth, to the land of their adoption, and to the Anglo-Saxon race." In closing, Mr. Thomson extended a most cordial invitation to all to visit his office when in New York, for "we are always glad to see Canadians."

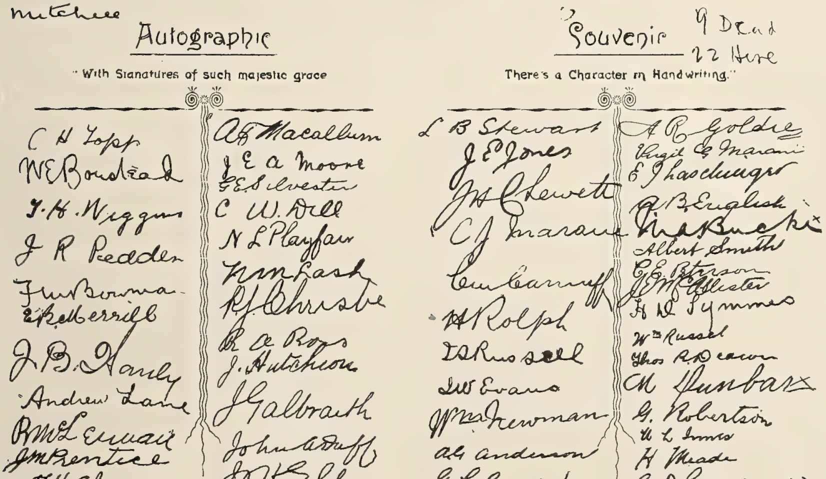
R. A. Sara, '09, in a humorous and entertaining speech, proposed the toast "To Our Graduates." In a happily used illustration from Mark Twain he emphasized the need of scientific training, and as an evidence that this Faculty is ably meeting the demands made upon it, indicated with pride the graduates present, who, endowed with the engineering knowledge obtained at the School, had gone forth and in a world of men are doing men's work. He also expressed the hope that the undergraduates would maintain the high standard set in engineering practice.

A high tribute was paid to Mr. C. H. Mitchell, who replied, for although late his very interesting address was listened to with close attention. He spoke very entertainingly of the first Engineering Society dinner and showed a slide of the menu used on that occasion, which is given below. His speech is given in full elsewhere.

Mr. L. E. Jones, '11, in a brief speech, proposed the toast to "Sister Institutions," and after replies by different representatives, the company sang the National Anthem and broke up about 1.30 a. m. During the evening musical numbers were rendered in excellent style by an octette, composed of Messrs. W. C. Blackwood, A. A. Kinghorn, J. Stuart, H. Stuart, W. Boulton, J. Craig, J. McKinnon, A. Sedgewick, and by Messrs. F. H. Chestnut, E. V. Chestnut, V. S. Chestnut, H. F. Secord in an orchestra with W. C. Collett as pianist and C. E. Bush as conductor.

T. K. Thomson

This feature was indeed a most acceptable contribution to the evening's enjoyment, as evidenced by the unstinted applause accorded the rendering of each selection. Needless is it to say, that in every respect the dinner was an unqualified success and too much credit cannot be given to the Committee who so ably assisted by Professor C. H. C. Wright and Mr. T. H. Hogg, demonstrated the feasibility of a function of such magnitude.



Mitchell

Autographic Souvenir

9 Dead
22 Here

"With Signatures of such majestic grace There's a Character in Handwriting."

C H Topp
W E Boustead
T. H. Wiggins
J R Pedder
F W Bowman
E K Merrill
J. B. Hanly
Andrew Laine
R McLennan
J M Prentice

A B Macallum
J E A Moore
G E Silvester
C W. Dill
N L Playfair
N M Lash
R J Christie
R A Ross
J. Hutcheon
J Galbraith
John A Duff

L B Stewart
J E Jones
J H C Hewett
C J Marani
C M Canniff
H Rolph
T A Russell
J W Evans
Wm Newman
A G Anderson

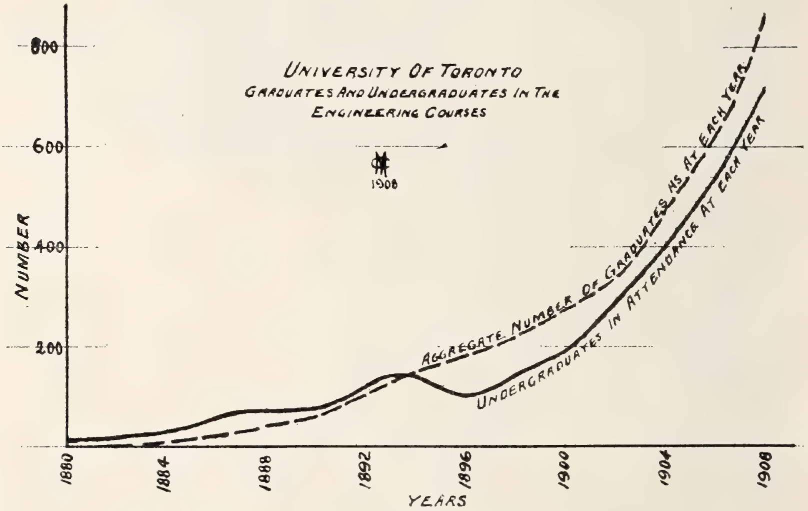
A R Goldie
Virgil G Marani
E Thaschinger
A B English
Wm A Bucke
Albert Smith
C E Peterson
J W McAllister
H D Symmes
Wm Russel
Thos R Deacon
C H Dunbar
G. Robertson
W L Innes
H Meade

THE ENGINEERING GRADUATES—A RETROSPECTION

CHARLES H. MITCHELL, C.E. (Tor.), '92.

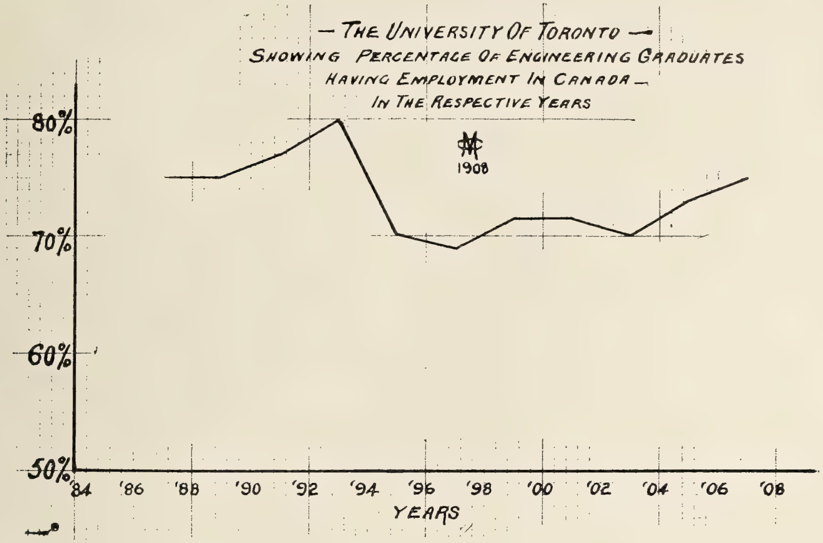
The reunion of graduates of the School of Practical Science and of the University in engineering at the recent banquet was an occasion to afford considerable retrospection. Perhaps the term and process of introspection might also be included as part of the operation of interviewing and inspecting ourselves as we hundreds of graduates of the past quarter century came together from the four quarters of the Dominion.

During the few days of the reunion and the hours of the banquet itself, the numerous groups of graduates intent upon each other after long separation, betokened the sifting out of many years' aggregate of experience and happenings. By the end of the period the sifting process was well advanced, the sizing and the classification of the various experiences being so complete that one so inclined could begin to find real mathematical laws and in some cases, almost actual formulae, by which the various graduates' work could be represented. That sounds academic perhaps, but there is "but little here below" that modern engineers cannot reduce to a science even if they are such vague matters as the wanderings of the peripatetic graduate, his various tastes for work and his probable earning power.

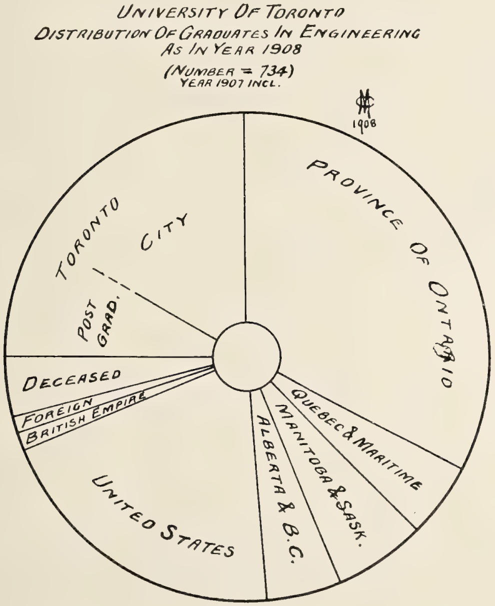


No. 1

It was with some half formed notions along these lines that, when, being honored with the request that I reply to the toast of the graduates at the reunion banquet, I assented and set myself


— The University Of Toronto —
Showing Percentage Of Engineering Graduates
Having Employment In Canada —
In The Respective Years
80%
70%
60%
50%
'84
'86
'88
'90
'92
'94
'96
'98
'00
'02
'04
'06
'08
Years
MC
1908

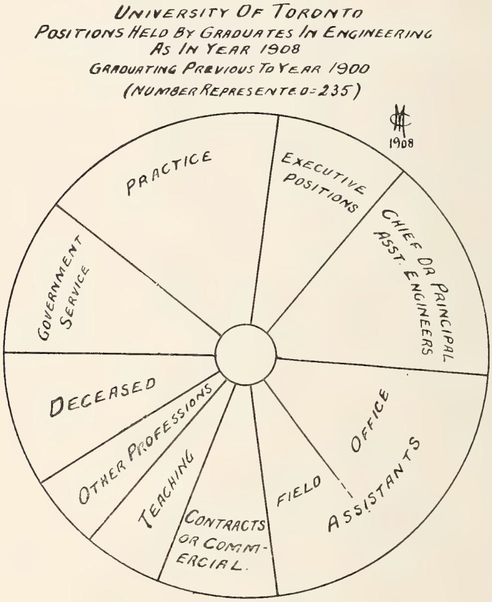
No. 2


University Of Toronto
Distribution Of Graduates In Engineering
As In Year 1908
(Number = 734)
Year 1907 incl.
MC
1908
Province Of Ontario
Toronto City
Post Grad.
Deceased
Foreign
British Empire
United States
Alberta & B.C.
Manitoba & Sask.
Quebec & Maritime

No. 3

the task of trying to represent the characteristics and movements of our graduates by graphical means. The novelty of this was my sole excuse for adopting such a means of delivering an after-dinner speech. The use of the lantern slide and screen as a medium of after-dinner speaking will, I hope, commend itself to the profession by reason of its practical features and its dumb eloquence so well adapted for service by the "Silent Faculty."

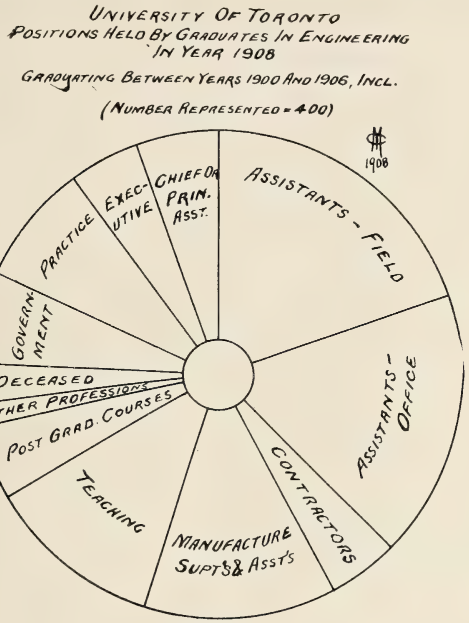
If an apology is needed for presenting the various graphical productions which follow I can only repeat that I believe this method of representation will more readily than any other, bring home to the university authorities and to ourselves the growing importance of the Engineering courses in the University of Toronto and the very intimate connection between its graduates and the vast country which we are all so busily engaged in developing.



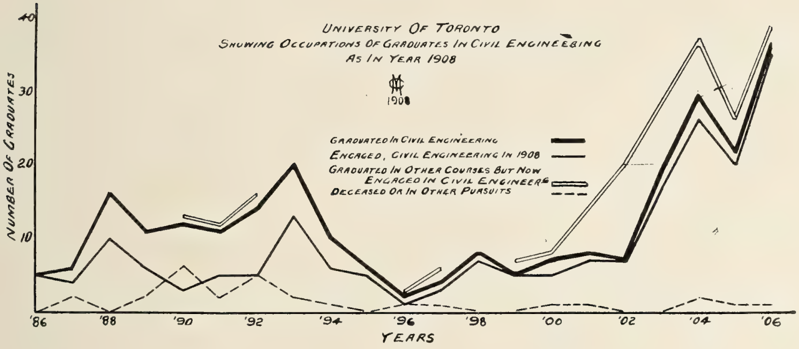
No. 4

The broken line shows the aggregate number of graduates up to any year while the full line shows the number of undergraduates in attendance in that particular year. The former is always increasing, the latter may vary. Note the extraordinary coincidence of the increase of students in attendance at the same rate and number as the graduates. This shows the rapid growth of the faculty.

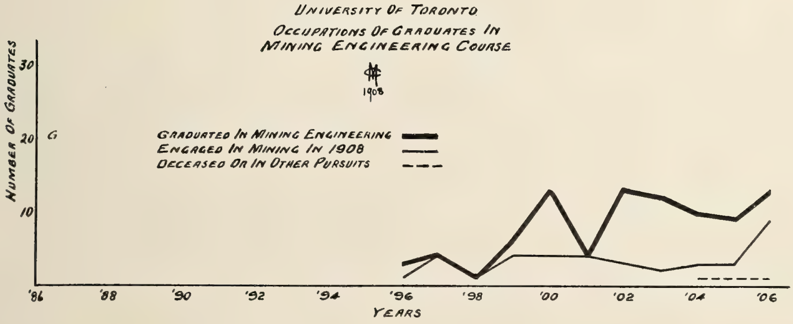
The percentage of graduates finding employment in Canada as the years progress. The curve is obtained by finding the


University Of Toronto
Positions Held By Graduates In Engineering
In Year 1908
Graduating Between Years 1900 And 1906, Incl.
(Number Represented = 400)
1908
Assistants - Field
Assistants - Office
Contractors
Manufacture Supt's & Asst's
Teaching
Post Grad. Courses
Other Professions
Deceased
Govern-ment
Practice
Exec-utive
Chief Or Prin. Asst.

No. 5


University Of Toronto
Showing Occupations Of Graduates In Civil Engineering
As In Year 1908
1908
Graduated In Civil Engineering
Engaged, Civil Engineering In 1908
Graduated In Other Courses But Now Engaged In Civil Engineering
Deceased Or In Other Pursuits
Number Of Graduates
10
20
30
40
'86
'88
'90
'92
'94
'96
'98
'00
'02
'04
'06
Years

No. 6

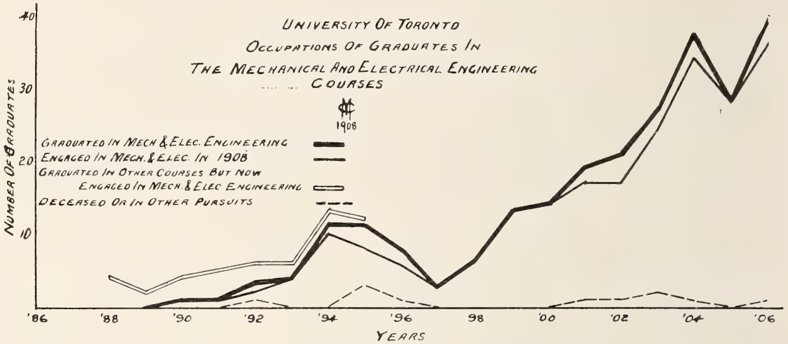

University Of Toronto
Occupations Of Graduates In Mining Engineering Course
1908
Graduated In Mining Engineering
Engaged In Mining In 1908
Deceased Or In Other Pursuits
Number Of Graduates
10
20
30
'86
'88
'90
'92
'94
'96
'98
'00
'02
'04
'06
Years

No. 7

percentage of graduates as registered in the School calendars from year to year, commencing in 1884. The financial depression of 1893 in the United States is clearly shown by the large percentage (80) of graduates who returned home to Canada and as the better times came the percentage remaining rapidly decreased until late years when it is increasing in a very marked manner due to the large works now in progress in this country.

Based on the graduates list in the Calendar of 1908 comprising the 734 graduates up to and including those of 1907.

Based on the list in Calendar of 1908, representing 235 graduates. Note that half the number of these older graduates were engaged in Government service, practice, executive positions and as chief or principal engineers, while those who were assistant engineers were less than a quarter of the whole.



No. 8

Based on the list in Calendar of 1908 comprising about 400 graduates between 1900 and 1906 inclusive. In this the four divisions named in diagram No. 4 constitute only a quarter of the whole while the assistants are over a half.

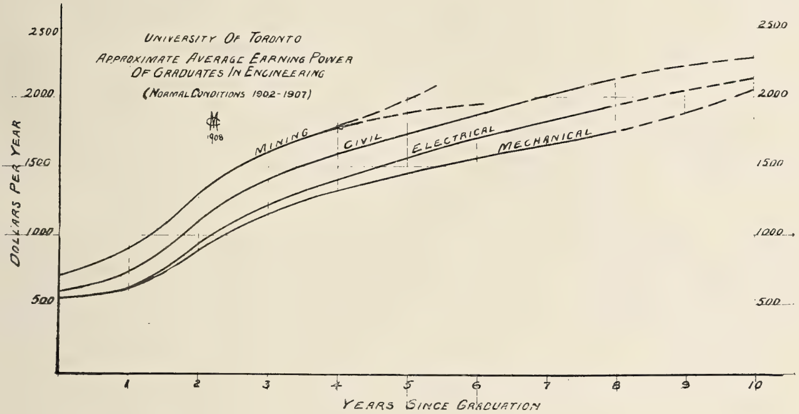
This diagram represents a concise history of the graduates in civil engineering year by year. The heavy full line shows the number of graduates in civil engineering in each year. The light full line shows the number of those of each year who, in 1908, were still engaged in civil engineering work, the remainder (i.e., represented by the space between these two curves) being either deceased or in other pursuits than engineering. The broken line shows the number of those deceased or in other pursuits. The double line, or rather the space between the double line and the heavy line, represents those graduates who were educated in other courses than civil engineering but who in 1908 were engaged in that branch of work; note this large increment between 1900 and 1905.

The fairly uniform number graduating in the civil course between 1888 and 1894, the small number between 1896 and

1902 and the rapidly increasing number since 1902 are to be noted as indicating development of the country.

This is drawn on similar lines to that of civil engineering. This course was instituted in the early 90's. It is to be noted, however, that there has been a very remarkable departure of graduates in mining from their specialty between 1899 and 1905, most defections being to the civil engineering as indicated in Diagram No. 6. This fact reflects the conditions of the country at that time. There had been a mining boom previous to 1900 which quickly died out and only within the past few years has activity in this branch of engineering again occurred. This is shown in the rapidly rising line at the end.

This diagram is similarly constituted to those of the other branches. The first graduate in this course was in 1890 and with the exception of the depression in 1897 common to all courses, the number of graduates has rapidly increased to the present. It is agreeably noticeable that nearly all graduates in this course have remained engaged in this branch and specialty and that the deaths and departures to other pursuits have been very small. The increment from other courses between 1888 and 1895 is due to the fact that in these earlier years there was no course in the School in mechanical and electrical engineering and this increment is composed of men who graduated in civil engineering.



No. 9

This diagram is offered for criticism and discussion with some misgivings. It will probably appear to be a very audacious method of indicating the dollars and cents side of the professional career of the young engineer. It must always be remembered, however, that the curves indicate the probable average earning power and that there are many exceptions to them, exceptions in the matter of high salaries and other emoluments which are well known amongst the graduate body.

These have been compiled having regard to the approximate earning power of the man and the money value of the position which he fills. Consultation with numerous graduates of different periods who are well acquainted with their fellows has formed the basis of the general trend of these curves, but at best they are of course the merest approximations, as no definite law can be deduced especially after five or six years out of college.

The mining graduate is undoubtedly the better paid immediately after graduation, largely due to his location and to the larger ratio of his muscle value to brain value. After four years, however, the miner appears to vary considerably and there are instances of mining graduates of five or six years' standing who are earning twice the amount indicated herein at that time.

All courses run fairly parallel the first two or three years with a rapid rise in all in the second year. The civil and electrical men run evenly side by side, the curves after six or eight years tending to flatten, although the electrical may trend upwards again with time as the graduate gets business connections of a larger horizon.

The mechanical graduate is apparently the most poorly paid in the first six or eight years, but after that period there is every indication that, as he begins to get an interest in the business with which he is connected, his curve rises steadily and, as he becomes a "manufacturer" in the broad sense, it will doubtless cross the other two curves. This is gratifying because it is an incentive to the young men to follow mechanical engineering pursuits in order to become manufacturers and thus provide what this country is most in need of.

It is hoped that this diagram will bring out considerable discussion and if the truth is to be told, it was largely with this in view that it was prepared.

HISTORY OF SCHOOL OF PRACTICAL SCIENCE.

W. HODGSON ELLIS, M.A., M.B.

Until the middle of the nineteenth century no attention was paid in England, and very little in America to the organized teaching of science and in particular to science in its applications to industry. Up to that time chemistry had been looked upon only as a part of a medical curriculum; engineering (other than military engineering) was learned only by apprenticeship; mineralogy and geology were not taught at all. The Exhibition held in 1851—parent of a numerous progeny—directed public attention in England to the possibilities of scientific invention and scientifically directed industry. The interest so awakened took the form, in the first instance of an attempt to teach elementary science to the artisan. This movement, of which South Kensington is the symbol, was called "Technical Education." It was begun with much enthusiasm. It gave rise to some disappointment. The efficiency of the British workman was not found to be perceptibly increased by his listening to lectures on technical science given by lecturers who often knew little of science and less of technology. Of course, much of the instruction was of quite a different character and excellent work was done in certain cases. On the whole, however, the results of this popular education did not come up to the expectations of its promoters.

In the United States scientific education followed the German model more closely than in England. There institutions after the model of the German Technical High Schools—that is, training schools for engineers and chemists—were established with most satisfactory results. When the need for technical education began to make itself felt in Ontario a commission consisting of Dr. I. G. Hodgins and Dr. McHattie was sent by the Provincial Government to study the question in the United States and Europe. As a result of their report a bill was introduced in the Legislature in 1871, by the Premier, Mr. John Sandfield Macdonald, providing for the establishment of a College of Technology for teaching mathematics, chemistry, modern languages, civil and mechanical engineering, and drawing.

The bill was strongly opposed in the House on the ground that its objects would be better met by giving additional aid to the Provincial University; but in the end it was carried and a grant of $50,000 made for the purpose of equipping a building for carrying out the plans. The building at the corner of Church and Adelaide streets, then occupied by the Mechanics' Institute, afterwards the Public Library, was purchased by the Government and fitted with the necessary laboratories, lecture rooms and drafting rooms. It was intended to combine the English and American systems of technical education by teaching regular

W. H. Ellis

students in engineering and chemistry during the day, and giving lectures to working men in the evening. Just before the new building was ready for occupation, the Sandfield Macdonald Government was defeated on another issue, and Mr. Alexander Mackenzie was called upon to form a new cabinet.

The members of this Government had, before they came into power, strongly apposed the scheme, which was now left to them as a legacy by their predecessors; and they did not carry it out without important modifications.

At first only the evening classes were organized. To conduct these Mr. James Loudon, afterwards President of the University, Mr. Wm. Armstrong, C.E., and the writer were appointed instructors. The classes, particularly Mr. Armstrong's classes in drawing, were largely attended.

The year 1877 marked the beginning of a new stage in the development of the young institution. In that year the Hon. Adam Crooks, Minister of Education, with the approval of the Lieutenant-Governor in Council, changed the name from "College of Technology" to "School of Practical Science," and recommended the erection of a building in the University grounds for the accommodation not only of the students of the School, but also for the science teaching of University College so that the School and the College might mutually help each other. This plan was devised by the Minister with the advice and assistance of the Hon. Mr. Justice Thomas Moss, Vice-Chancellor of the University, Dr. (afterwards Sir Daniel) Wilson and Professor James Loudon.

In accordance with this plan, the north wing (just condemned as unsafe) of the present Engineering Building, was erected; and it was opened on the 1st of October, 1878. This building contained a chemical laboratory under the charge of Professor Croft to whom the present writer was assistant. The chemical laboratories were in the rooms just vacated by Mr. Anderson and Professor Wright and all the chemical teaching of University College and of the School was carried out there and in the lecture room in connection with them.

The basement was occupied by Professor Chapman as an assay laboratory. There was another lecture room on the first floor and a drafting room (at the east end). This constituted the quarters of the Engineering Department and was under the charge of Professor Galbraith. The floor above was devoted to the Department of Biology and was presided over by Professor Ramsay Wright. Professor Loudon had a room on the ground floor, but all his teaching was done in the round tower at the west of the main building.

Professor Croft was Chairman of the Board and Professor Ramsay Wright secretary. The whole of the engineering teaching, including the drawing, was done by Professor Galbraith.

In those days the School of Practical Science was in fact, though not in name, an integral part of the University. It was supported by annual grant of the Legislature, not out of the University endowment; and it was not under the control of the Senate; but the students received instruction side by side with the students of University College, from the same professors; and it was governed by a Board of whose seven members, five, including the chairman and secretary, were professors in University College.

In 1889 there was another change. The University Federation Act was passed in 1887 establishing a University Teaching Faculty, and removing the professors of chemistry, physics, mineralogy and geology, and biology from University College to the Teaching Faculty of the University. This severed the connection between the School and University College. In October, 1889, the School of Practical Science was affiliated to the University of Toronto and in November of the same year Professor Galbraith was appointed principal and the management of the School was "entrusted to a Council composed of the Professors, Lecturers and Demonstrators appointed on the Teaching Faculty of the School."

The first Council was composed of: Principal Galbraith, Professor of Engineering, Chairman; W. H. Ellis, Professor of Applied Chemistry; L. B. Stewart, Lecturer on Surveying, Secretary; C. H. C. Wright, Lecturer on Architecture; and T. R. Rosebrugh, Demonstrator in the Engineering Laboratory.

The University Departments of Biology, Mineralogy and Geology, and Chemistry were now removed from the School to quarters of their own.

The next step forward was the enlargement of the Engineering Building and the equipment of the engineering and metallurgical laboratories.

The diploma of the School of Practical Science was at first given only in Civil and Mechanical Engineering and Analytical and Applied Chemistry. Subsequently Mining Engineering and Architecture were added.

In 1892 a fourth year of instruction was added to the three required for the diploma, at the end of which the student might obtain the degree of B.A. Sc. In 1900 the Senate of the University passed a statute adopting the School of Practical Science as the Faculty of Applied Science of the University of Toronto. In 1901, the Chemistry and Mining Building was begun and relief given for the time to the overcrowded condition of the laboratories and drafting rooms which had become serious.

On the 3rd of October, 1905, a Royal Commission was appointed to enquire into and report upon a scheme for the management and government of the University of Toronto and University College. The advisability of the incorporation of the School of Practical Science with the University of Toronto; and certain other subjects. In April, 1906, the Commission reported, recommending, among other things, as follows:—

1. The powers of the Crown in respect to the control and

management of the University, should be vested in a Board of Governors chosen by the Lieutenant-Governor-in-Council.

2. The Senate should direct the academic interests of the University.

3. The School of Practical Science should be united with the University as its Faculty of Applied Science and Engineering.

On the 14th of May of the same year, the Legislature passed the University Act carrying out the recommendations of the Commission, clause 6 of which reads:

The School of Practical Science is hereby united with and shall form part of the University and constitutes the Faculty of Applied Science and Engineering thereof.

On the 15th day of the following June this Act went into force and with that the School of Practical Science became de jure what it had always been de facto—the Faculty of Applied Science and Engineering of the University of Toronto.

HISTORY OF THE APPLIED SCIENCE BUILDINGS.

C. H. C. WRIGHT, B.A. Sc.

In order to furnish accommodation for the teaching of engineering, in accordance with the proposition of the Hon. Adam Crooks, the north wing of the present Engineering Building was erected in 1877-78, and called the School of Practical Science. This building was heated with hot air and the furnaces together with their flue and supply of coal occupied a large portion of the basement. In the western portion, however, there were situated the mineralogical and assaying laboratories, over which Professor E. J. Chapman presided. The ground floor was occupied by Professor H. H. Croft and his students in chemistry. The western wing of the first floor was also devoted to chemistry, while the remaining five small rooms in the centre and eastern wing were devoted to engineering, and here Professor J. Galbraith with his small class started work in 1878. In the attic the department of biology was presided over by Professor R. Ramsay Wright. Thus, this small building housed the departments of mineralogy, geology, chemistry, engineering and biology, and in it were trained side by side students in Arts, Medicine and Engineering.

In order that the Province of Ontario might keep pace with other countries in the education of the engineer, it was decided in 1888, to establish engineering laboratories in connection with the S.P.S., in which might be studied those important problems in strength of materials, hydraulics, thermodynamics and electricity, which were occupying the attention of the engineering world. This rendered necessary extensive equipment as well as considerable building accommodation.

For this purpose, the construction of the central portion and southern wing of the present Engineering Building was undertaken immediately. This addition was completed and first occupied in the fall of 1890. In the spring of this same year the eastern portion of the Main Building of the University, in which was situated the library, was destroyed by fire, and until the new library building was erected, the library was provided for on the top floor of the central portion of the S. P. S. Reading room accommodation was obtained by building an extra story over the eastern and western parts of the present north wing of the School.

C. H. C. Wright, B.A. Sc.

Gradually, by the erection of new buildings, the Arts departments were removed, until in 1894, the S.P.S. was devoted entirely to the work of the School. The Chemistry and Mining Building, facing College Street, was completed in 1905, and provided accommodation for the departments of chemistry, mining, mineralogy and geology of the School, and for those of mineralogy and geology of the University. Immediately to the north of the Chemistry and Mining Building was erected about the same time the Milling Building, for the accommodation of that branch of Mining. In the fall of 1901, a small observatory was built for the department of Astronomy of the S.P.S. This building was replaced by the larger one now in use, which provided in addition to the observation room, a small calculating room. It is hoped that by October, 1909, the new building to the east of the Main Building of the University will be completed and occupied by this department.

At present there is under construction to the south of the Engineering Building a laboratory for thermodynamics and hydraulics, which promises to be ready for the work of the coming session, 1909-10, and will provide excellent facilities for the advancement of this very important branch of engineering education. In addition, it will also offer opportunities for research work along these lines.

For the past two sessions the Second Year draughting has been accommodated in the Examination Hall of the University, and during the present session, the Third Year draughting in the departments of Civil and Mining Engineering has been accommodated in the Physics Building.

It is apparent to anyone who has studied even casually the progress of engineering education, that thirty years ago the demands for building accommodation were very few:— a lecture room together with a draughting room for the engineering side of the work; a lecture room for mathematics, and space for a little chemistry and physics, was all that was deemed necessary. However, as the benefits of education suitable for the different divisions of engineering, civil, mining, mechanical and electrical, became apparent to the world, the demands for laboratory accommodation have increased very rapidly. In addition to the increase in accommodation required for improvements in the educational requirements, must be considered that due to the increased numbers of students taking these courses; and, if the University of Toronto and the Province of Ontario wish to maintain the good name won by the School of Practical Science, they must be prepared to provide large additions in building and equipment in the immediate future. Situated as Toronto is in the centre of the clay industries (the largest industries of the Province) something should be done for Ceramics. Electrical engineering demands the lower floors of a large building, and at the same time, the requirements for the study of the strength and properties of building materials, including cement and reinforced concrete, must not be neglected.

President Falconer, writing on "The Needs of the University of Toronto" in the pages of "The University Monthly," says: "The University has within a short time become one of the largest in the British Empire and stands in the front rank on this "continent." . . . . "During the last two years, not including the present, the ratio of increase in the Faculty of Applied Science has been thirty-two per cent., a larger proportionate increase than in any other Faculty." . . . "The most "urgent pressure for accommodation during the past winter, "apart from the necessity for schools for the Faculty of Education, was in the Faculty of Applied Science. This Faculty is "housed in the old Engineering Building built for the School of "Practical Science, and in the new Science building facing on "College Street, commonly known as the Chemistry and Mining "Building. These buildings are not sufficient for the needs of "this Faculty."

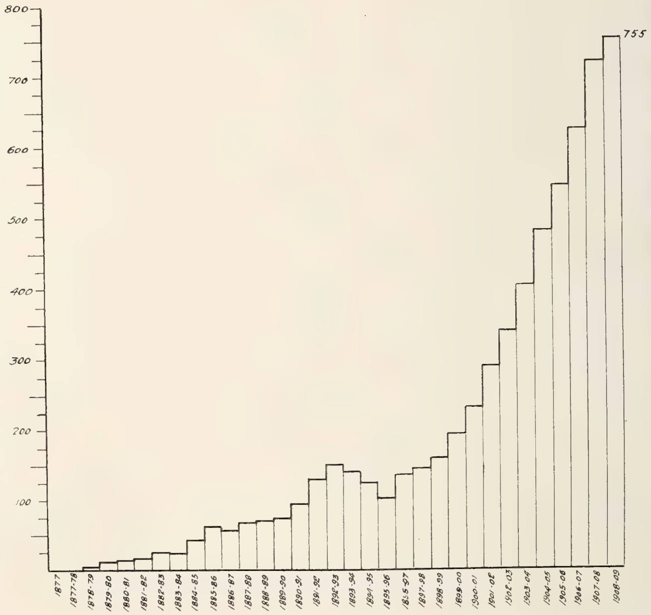


Diagram Showing the Growth in Attendance

THE NEEDS OF THE FACULTY OF APPLIED SCIENCE.*

PRESIDENT R. A. FALCONER

Unless all omens fail the Faculty of Applied Science will soon become the second in size in the University, and may creep up upon the Faculty of Arts, though Arts has such a lead that it will probably hold the first place for many years. During the last two years, not including the present, the ratio of increase in the Faculty of Applied Science has been thirty-two per cent., a larger proportionate increase than in any other Faculty. It is also worth mention that a much larger proportion of the students of this Faculty than of those in the Faculty of Medicine come from the city of Toronto. About a third of the whole number have their homes in this city, the reasons for which may not be very difficult to discover.

This Faculty has developed healthfully and in conformity with the demands of the country. Ontario has become a great manufacturing province without at the same time ceasing to develop its agriculture. The Agricultural College at Guelph is a splendid evidence of the good hope that lies before our farming population. For the other side of our life we also need leaders —in opening up new country by railways, in constructing large works, in developing mines. For producing men who will direct these activities there is the Faculty of Applied Science, formerly known as the School of Practical Science.

A distinction must be kept clearly in mind. The aim of the Faculty of Applied Science is not to be confounded, as is sometimes done, with the work of technical education. The latter consists on the one hand of giving artisans and the youth in school instruction in the scientific principles that underlie the various trades in which they may be engaged, and on the other hand of instruction in the principles and technique of the actual trades. Technical education is meant for the man who, whether as foreman or skilled workman, is engaged in some trade. And a highly honorable function does this man perform for the commonwealth. More and more demand arises for a supply of such intelligent, well-trained, capable men who take pride in their trade. Those men who are seeking to direct the attention of the public to the necessity of providing this technical education are engaged in a good work.

In the Faculty of Applied Science, however, students are being trained who will become the directors of the works in which the technically trained men will be employed. They should be trained men of the manifold industrial activities of the

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* This is one of a series of articles on "The Needs of the Univerity of Toronto," contributed to the *University Monthly* by President Falconer.

Robt. A. Falconer.

country. As workmen they may perhaps be actually unskilled, but they must know how the work should be done, and be able to detect its worth and appraise its value.

The complexity of our industrial life, the variety which is daily increasing, and the rapid expansion of our population, as well as the rise in the scale of comfort, will not only bring more students into this Faculty, but will occasion additions to the departments taught within the Faculty. At once the question arises, is there to be no limit to this development? Are we to keep on adding new departments indefinitely? We have not as yet gone far beyond the ordinary branches, the object of the Faculty having been to lay deeply and well the principles of science by means of concrete applications of these principles in the few leading departments into which most students turn. There are at present the departments of Civil Engineering, Mining Engineering, Mechanical and Electrical Engineering, Architecture, Analytical and Applied Chemistry and Chemical Engineering. As has already been remarked, these have been established to meet the requirements of the life of the Province. The relative numbers in attendance in the past may very probably change in the future, as for example in mining, as Ontario becomes increasingly a mining province.

In connection with this Faculty there is the pressing need of more room. One of the best objective evidences of its growth is shown by looking at the northern part of the old Engineering building which was erected in 1878 for the school of Practical Science, and then turning to the buildings now used by this Faculty. This old building has been greatly enlarged but has been long filled. Then came the new building on College Street, one of the best in the whole group on the University grounds. In the old building there are the departments of Electrical Engineering, Strength of Materials, Surveying, Drafting, Physics and Architecture, and at present also Thermodynamics and Hydraulics. In the new building are Chemistry, Electro-chemistry, Geology, Mineralogy and most of the lecture-rooms used by this Faculty. In its eastern wing is the valuable palaeontological museum. The mining department is housed in a building in the rear.

Last year the plans of the Convocation Hall were further enlarged by the erection in the rear of the large hall. It is used for examinations and also for drafting. So far the Drafting has been confined to the students of the second year. A large amount of space is required for this department inasmuch as the policy of the Faculty has been to give each student a desk at which he is supposed to spend all the time that he is not at lectures or in some laboratory. Drafting thus occupies a very large share of his attention. Hitherto each student has had his own desk, and unless it should be found possible in some of the work to have two students at one desk, there must be an increased space devoted to Drafting.

Until the new building for Thermodynamics and Hydraulics was under way it was impossible to draw up a four years' course in this Faculty. The structure is to be ready for occupation by the autumn and with its equipment will provide ample opportunity for this important side of Engineering. The removal of the Thermodynamic department from its present extremely congested quarters will allow for some expansion of the departments of Electrical Engineering and Strength of Materials, though if the increase of students continue this cannot be much more than a makeshift for a short time. According to the plans of the architect a handsomely designed addition to the new Thermodynamics and Hydraulics laboratory facing on the main entrance to the University from College Street will serve both to adorn the approach and to provide some much needed accommodation until part or all of the old Engineering building can be replaced by a new structure.

In a Faculty where so much of the instruction must be given in laboratories equipped with expensive apparatus or machinery it is necessary to spend money on buildings. And most of these buildings hitherto erected have been devoted to departments already taught in the Faculty. But, as has been stated, new departments must be originated. With the development of the mines of Northern Ontario an immense impetus has been given to this side of industrial life. Fortunately our mining equipment is good, and under the direction of Professor Haultain, who has had a thorough experience in mining, we may reasonably expect that the University of Toronto will have a large share in training those who are to develop the immense mineral resources of the Province. Closely akin to Mining is Metallurgy. There is metallurgy of gold and silver, but more important for a Province with large manufactures is the metallurgy of iron and steel. It cannot be long until the instruction now given in this subject will be greatly increased. Other departments in which extension may be demanded within a short period are Architecture and Applied Chemistry. Already the architects have approached the University with the object of getting additions made to the department in the way of practical design. In Applied Chemistry there will come developments in the application of chemical science industrially. Even if we do not adopt the policy of attempting to provide for every branch of Engineering education, we must at least prepare men for launching and guiding those industrial activities which are most adapted to the natural resources of this Province. All development of this kind is expensive, both for the undergraduate and the graduate student.

In considering the necessary additions to the staff occasioned both by the rapid increase of the students and of the subjects to be taught, it is necessary to bear in mind that men fitted to develop important departments of the Faculty of Applied Science are able to earn good incomes at present, and that there are also many opening for young men of ability which will bring them in much more within a few years than they would earn in the University in the same time. And yet it is of immense importance for us to have men who have some training of a practical character besides their academic equipment. Their experience is extremely valuable in giving them selective faculty and power of adjustment of theory to practical necessities. This has to be taken into account when any addition to the staff or department is contemplated. While a few men will be content with a small salary in a university faculty because the position is supposed to be secure and free from many of the difficulties of a practical engineer's life, many of the brightest and most energetic minds are drawn to the active exercise of their profession. Some men of this sort are required in a faculty; and the salary is a factor that cannot be neglected.

THE ENGINEERING SOCIETY OF THE UNIVERSITY OF TORONTO

T. H. HOGG, B.A.Sc.

The Engineering Society of the Faculty of Applied Science and Engineering of the University of Toronto was founded in 1885, being known at that time as the Engineering Society of the School of Practical Science. The names most intimately connected with its beginning are Messrs. Herbert Bowman and T. Kennard Thomson, who were undergraduates at that time. It is essentially a student's society and only graduates and undergraduates in Engineering of the University are admitted as ordinary members.

The objects of the Society according to the Constitution are:

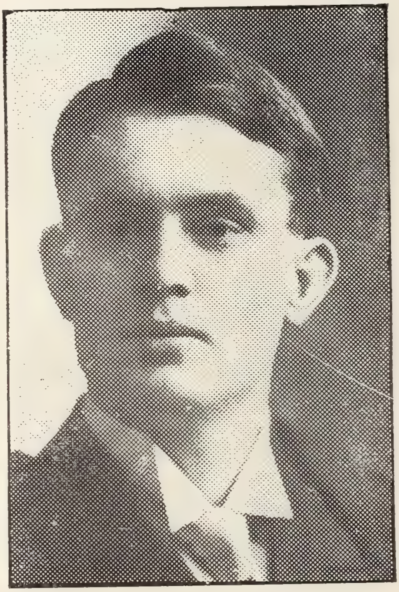
1. The encouraging of original research in the Science of Engineering.
2. The preservation of the results of such research.
3. The dissemination of these results among its members.
4. The cultivation of a spirit of mutual assistance among the members in the practise of the profession of Engineering.

The membership of the Society has risen steadily in point of numbers since its inception. It began with a total membership of about thirty. At the present time of ordinary members there are 750 with a life membership of about the same, making a total of nearly 1,500.

For the first few years of its existence, membership for the undergraduates was optional, but recently through the co-operation of Dean Galbraith, it has been made compulsory for all in attendance in the Faculty, a fee of $1 per year being imposed and collected with the regular tuition fees.

Until the fall of 1908 meetings were held each alternate week of the academic year: that is from October until April. The Executive Committee then decided that the time had come for a division of the Society, as the meetings were becoming too large and unwieldy, for good discussions of the papers presented. The constitution, too, had become inadequate, not having been revised since the founding of the Society. A new constitution was therefore drafted and in this provision was made for sectional meetings, the members being grouped according to the courses taken, the Civils and Architects, Mechanicals and Electricals, and Miners and Chemists forming three divisions. These smaller meetings are held alternate to the general meetings, and at them papers of more specialized interest are read. By this means a much freer discussion is obtained and many more of the undergraduates are enabled to prepare papers and deliver them. These smaller meetings are presided over by the vice-presidents of the respective sections, and no business of a nature affecting the Society as a whole is transacted. The general meetings are reserved for business and for topics of general interest to the student body. As a natural outcome the papers given at the sectional meetings are nearly all by undergraduates while those given at the general meetings are by graduates and men prominent in the outside world.

H. E. T. Haultain
First Student President of Society



R. J. Marshall
Present President of Society

The appointment of a permanent secretary in the fall of 1908 marks a turning point in the affairs of the Society. For a number of years, certain supplies had been handled for the students, the revenue accruing from the sale of these being used for the expenses of carrying the Society along. This branch became so large that it was found necessary to appoint a secretary who would devote his time to the ordering and sale of supplies, and the other work incidental to the organization. The Society now handles, at a slight increase in cost, all draughting supplies, etc., used in the Faculty, thus affording a great reduction over the old prices.

In its infancy the question of funds was a serious one with the Society, but happily that worry is now over. Each undergraduate in the Faculty pays an annual fee of $1. This, with the income from the sale of supplies makes a sum which allows of the handling of many departments of advantage to the students and to the Faculty in general. Probably the most important of these departments is the publication of the Society monthly, "Applied Science." Before saying more of this, we must trace its development. In the early days of the Society the transactions, containing the papers read at the meetings, were issued yearly. The first volume of the Transactions was published in 1886, and was a pamphlet of 43 pages. In the then financial condition of the body this was a serious undertaking, as about 500 copies were issued. A gradual increase in membership together with a great development in enthusiasm caused the sending out in 1895, of advance proofs of the papers read, for discussion. This was too much of a forward step and in consequence the Society was nearly swamped. Eventually it recovered its lost ground and from that time until 1906 there was a continuous development in the size of the pamphlet. The No. 20 issued in 1906-1907 had about 250 pages and was very fully illustrated.

With the division of the Society into sections and the increased number of papers forthcoming on that account, it was decided to change the publication to a monthly. This was done in 1907, and the monthly, "Applied Science," was enthusiastically received by all the graduates.

At the present time "Applied Science" is a thoroughly progressive and up-to-date periodical, not of interest merely to graduates of the Faculty nor courting inspection as an academic journal, but resting on its merits as an engineering magazine. It has to-day a circulation of 1,700 copies. There are exchanges with all engineering societies and periodicals in the United States and Canada. The articles appearing in it have been copied in nearly all the leading engineering publications. "Applied Science" in its short life has done much towards cementing together the graduate feeling, and according the Faculty the recognition among engineers and the general public which it deserves.

As the organ of the Engineering Society, and as an outward manifestation of what the Society is, the monthly has well justified its existence.

As the membership increases and each year of added tradition puts new enthusiasm into the work of the Society, one looks back on a connection with the Society with pride, and a feeling arises that, with the strong cohesion and power of initiative exhibited by its executive committees in the past, there must certainly be a broad field of action for the Society in the future. While it is true that its work is mainly carried on by students, still not all of its benefits are conferred on its members alone, and we hope in the future that the Engineering Society with its strong, compact organization, will do much towards procuring for engineers the recognition from the general public which they deserve.

ADDRESS—DEAN GALBRAITH.*

Gentlemen, — Custom in this Society demands of the retiring president, whether wisely or otherwise it is not for me to say, an address at the close of his term of office. Fortunately for him no by-law exists governing either the form or matter of his essay. He is not required to confine himself to the third person and has all the freedom implied in the declaration, printed in every volume of the "Transactions," that "the Society will not hold itself responsible for any statements or opinions which may be advanced in the following pages." Answerable thus to no one and confined only by my natural limitations, I jotted down from time to time, by way of gathering material, ideas as they occurred to me. When a sufficient number had accumulated to enable me to form a judgment of their suitability for the purpose in view, I was dismayed to find that my stock was shopworn and that it would not be an easy task to work it into presentable shape. However, it was then too late to throw it away. After a period of severe reflection I convinced myself that it might be of some value to the younger members of the profession and that even the seniors might be interested in the viewpoint of an engineering teacher, differing as it does in many respects from their own. I decided, therefore, to form my material into a paper under the somewhat hackneyed title of "The Engineer and His Work."

In tracing backwards the history of the engineer to classical times, two words stand out with marked prominence— *μηχανή* and *ingenium*. The root idea of the former is contrivance, resource, ways and means; of the latter, nature, intelligence, ingenuity. The phrase "mechanical genius" describes the highest attribute of the engineer, the control of mind over matter, the power of bending the forces of nature to the use and convenience of man. The antiquity of the words and the continued application of their derivatives down to the present day to the same set of ideas are evidence that the art and craft of the engineer are not of yesterday nor the outcome of modern conditions. The remains of the great structures of ancient civilizations — temples and amphitheatres, baths, aqueducts and sewers, walled cities and military roads, are witnesses to the genius of engineers whose names have been long forgotten, of men skilled in surveying, levelling, drawing, hydraulics, excavation and construction. The entrenched camp, the tunnelled approach, the battering-ram, catapult and moving tower were the devices of the engineer. He had a great part then as now in the arts of peace and war.

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* Address by Dean Galbraith, Retiring President of the Canadian Society of Civil Engineers, delivered at the annual meeting of the Society in Toronto, January 27th, 1909. Printed with the permission of the Council.

An inscription on a marble altar discovered in 1866 near Lambaese, Algeria, of date A. D. 152, contains a petition from Varius Clem-

J. Galbraith, M.A., LL.D.

ens, governor of Mauritania, to Valerius Etruscus, governor of Numidia. It reads as follows:

"Varius Clemens greets Valerius Etruscus and begs him in his own name and in the name of the township of Saldae to dispatch at once the hydraulic engineer of the Third Legion Nonius Datus with orders that he finish the work which he seems to have forgotten." The petition was favorably received by the governor and by the engineer Nonius Datus, who when he had fulfilled his mission wrote to the magistrates of Saldae the following report:

"After leaving my quarters I met with the brigands on my way, who robbed me even of my clothes and wounded me severely. I succeeded after the encounter in reaching Saldae where I was met by the governor, who after allowing me some rest took me to the tunnel. There I found everybody sad and despondent; they had given up all hopes that the two opposite sections of the tunnel would meet, because each section had already been excavated beyond the middle of the mountain and the junction had not yet been effected. As always happens in these cases, the fault was attributed to the engineer, as though he had not taken all precautions to ensure the success of the work. What could I have done better? I began by surveying and taking the levels of the mountain; I marked most carefully the axis of the tunnel across the ridge; I drew plans and sections of the whole work, which plans I handed over to Petronius Celer, then governor of Mauritania; and to take extra precaution I summoned the contractor and his workmen and began the excavation in their presence with the help of two gangs of experienced veterans, namely a detachment of marine infantry and a detachment of Alpine troops. What more could I have done? Well, during the four years I was absent at Lambaese expecting every day to hear the good tidings of the arrival of the waters at Saldae, the contractor and the assistant had committed blunder upon blunder; in each section of the tunnel they had diverged from the straight line, each towards his right; had I waited a little longer before coming, Saldae would have possessed two tunnels instead of one."

Nonius Datus, having discovered the mistake, caused the two diverging arms to be united by a transverse tunnel; the waters of the Ain-seur could finally cross the mountain and their arrival at Saldae was celebrated with extraordinary rejoicings in the presence of the governor, Varius Clemens, and of the engineer. (Lanciani—Ancient Rome in the Light of Modern Discoveries.) We can, I am sure, sympathize with our confrere the engineer of the Third Legion in his difficulties, and rejoice with him in his triumph.

The Romans as a rule constructed their aqueducts with grades approaching those of our modern railways. They tunneled mountains and bridged valleys, not, it must be remembered, that they were ignorant of the fact that water could be carried across valleys in inverted siphons, but because they were unacquainted with the use of cast iron. There is at least one instance of a masonry or perhaps a concrete pipe constructed by the Romans which was able to withstand pressures as high as ten atmospheres.

The first advance in engineering after the time of the Romans was due to the invention of gunpowder in the beginning of the fourteenth century, or perhaps it may be more correct to say, to its introduction into Europe about that time. By it the methods of excavation and of attack and defence were revolutionized.

The next great step was the introduction of iron as a structural material, which was rendered possible by the use of coke as a blast furnace fuel in the early part of the eighteenth century. Following the manufacture of coke iron came Watt's epoch-making improvements in the steam engine in the latter part of the same century—the separate condenser, expansive action, the double acting cylinder, the steam jacket, the parallel motion, the throttle valve, the governor, the water gauge, the indicator, and many others. Watt also conceived and patented in 1782 the idea of the compound engine, which he thus described: "A new compound engine or method of connecting together the cylinders and condensers of two or more distinct engines so as to make the steam which has been employed to press on the piston of the first act expansively on the piston of the second, etc." Watt, in fact, gave the world the steam engine which exists to-day, the improvements made since his time being as nothing compared with his. The achievements and personality of James Watt cannot be better described than in the words of Sir Walter Scott after meeting him in 1818:

"There were assembled about half a score of our Northern Lights. . . . Amidst this company stood Mr. Watt, the man whose genius discovered the means of multiplying our national resources to a degree perhaps even beyond his own stupendous powers of calculation and combination; bringing the treasures of the abyss to the summit of the earth—giving the feeble arm of man the momentum of an Afrite—commanding manufactures to arise as the rod of the prophet produced water in the desert—affording the means of dispensing with that time and tide which wait for no man and of sailing without that wind which defied the commands and threats of Xerxes himself.

This potent commander of the elements, this abridger of time and space—this magician whose cloudy machinery has produced a change on the world, the effects of which, extraordinary as they are, are perhaps only now beginning to be felt, was not only the most profound man of science, the most successful combiner of powers and calculator of numbers as adapted to practical purposes—was not only one of the most generally well-informed, but one of the best and kindest of human beings.

There he stood, surrounded by the little band I have mentioned of northern literati, men not less tenacious generally speaking of their own fame and their own opinions than the national regiments are supposed to be jealous of the high character they have won upon service. Methinks I yet see and hear what I shall never see or hear again. In his eighty-second year the alert, kind, benevolent old man had his attention alive to every one's question, his information at every one's command. His talents and fancy overflowed on every subject. One gentleman was a deep philologist—he talked with him on the origin of the alphabet as if he had been coeval with Cadmus—another a celebrated critic—you would have said the old man had studied political economy and belles-lettres all his life—of science it is unnecessary to speak, it was his own distinguished walk. And yet, Captain Clutterbuck, when he spoke with your countryman, Jedediah Cleishbotham, you would have sworn he had been coeval with Claver'se and Burley with the persecutors and persecuted, and could number every shot the dragoons had fired at the fugitive Covenanters. In fact we discovered that no novel of the least celebrity escaped his perusal, and that the gifted man of science was as much addicted to the productions of your native country, in other words as shameless and obstinate a peruser of novels as if he had been a very miller's apprentice of eighteen."

One scarcely knows which to wonder at most, the genius of the engineer or the vision of the poet.

Sir Humphrey Davy said of Watt: "He was equally distinguished as a natural philosopher and a chemist and his inventions demonstrate his profound knowledge of these sciences."—(Muirhead's Life of James Watt.)

Watt was not only the greatest of mechanical engineers—he was an expert surveyor and civil engineer as well. He spent several years of his life in making surveys and reports on harbors, docks, canals, water works, bridges, etc. He invented a quadrant, a surveyor's micrometer, clock, and other instruments of precision. As an illustration of the rate of pay of civil engineers in 1770, Watt's charge for the survey of the Strathmore Canal may be of interest. The field work covered 43 days for which he charged £80 including travelling and living expenses; for the preparation of the report he was paid the further sum of £30.

The manufacture of iron on the large scale has been accompanied within the last thirty years by an enormous expansion in the manufacture of Portland cement and the consequent return to the use of concrete as a structural material. Within the same period the development of the dynamo has marked another advance comparable in importance only with that of the steam engine. It is not to be supposed, however, that these modern features have entirely absorbed the energies of the engineering and industrial world. Few of the ancient arts and manufactures have lost their importance. They have undergone development and transformation under the light of modern science and the stimulus of modern conditions. Through all these changes man, their author, seems to survive almost unchanged. The human race, civilized or savage, is, man for man, very much the same as it was three thousand years ago. Nonius Datus had the full qualifications for admission into the Canadian Society of Civil Engineers. No one would recognize any essential difference between him and other members, except perhaps that he was better educated, being able to talk Latin.

It will be unnecessary to recite to an audience of engineers in any minute detail the various fields of activity now open to the profession. It may be useful, however, to attempt a classification of the functions of the engineer irrespective of the special branch in which he may be engaged. They may be roughly analyzed as follows:

1. Design—the preparation of the drawings, specifications and estimates of cost for works not yet in existence—the study of the problem, the devising of ways and means—in short, the consideration of all questions affecting the construction and efficiency of the contemplated work.
2. Survey and inspection—making the examination of existing works or ground for the purpose of determining necessary extensions and changes—laying out new work—measuring work done—inspection of materials and workmanship, and generally, the superintendence of construction.
3. Superintendence of the operation and maintenance of works in running condition.
4. Determining and estimating costs of various kinds.
5. Reporting upon various physical and financial features of existing or proposed works.

To successfully perform these functions the engineer must have knowledge, training, experience, judgment, resourcefulness, business capacity and ability to deal with men, in fact the qualifications which are necessary for success in any line of life. It goes without saying that he should be an educated man in the best sense of the term. It has sometimes been said that the engineer should be forty per cent. engineer and sixty per cent. man; one might better say that he should be one hundred per cent. engineer and one hundred per cent. man, the terms engineer and man not being, it is to be hoped, mutually exclusive. It is necessary that he should have a thorough grasp of the objects and methods of the promoters and proprietors of the works on which he is engaged and be quick to discern where expense may be saved, keeping the necessary efficiency in view. It is not requisite that he be an expert mathematician, chemist, physicist, geologist, biologist, metallurgist, mechanic, accountant, lawyer or political economist, but it is desirable that he be an expert engineer. For this purpose he should have a sound acquaintance with the principles and possibilities of various branches of specialized knowledge in so far as they bear upon his own work.

In other words, he should have a clear perception of how and how much these branches may aid him in his own problems and be able to determine at any time to whom he should go when his own knowledge is insufficient. He must know the limitations of his own profession and therefore should know something of the fields which surround his own. Often it happens that some particular fence has almost disappeared and it becomes difficult to determine where the engineer ends and the neighboring proprietor begins. Indeed, it may be said that the fences are continually changing so that the engineer never can hope to be in the position of not requiring to study non-engineering things. The training to be given in the engineering schools should deal more with subjects which are not engineering than with those which are, the reason being that the time for such training is short whereas that to be devoted to engineering is long. Above all, the curriculum should be educative, the student should be trained in clear thinking and in clear expression. When he graduates he should have acquired a sufficient knowledge of his geography to have some idea of where he is in the world in general and in the engineering world in particular. It is now recognized that the study of the applied sciences has all the educational advantages usually attributed to that of the pure sciences. They involve the same principles, exercise the same faculties and produce the same educational results as the pure sciences. The fact that their objects are wholly economic does not detract from their educational value but provides an additional stimulus to scientific effort. The term "applied science," at one time suitable, is now rather misleading in connection with the science taught in the engineering schools. It suggests the idea that the business of the teachers in these schools is to train their students in the application to practical purposes of pure science. This is far from being the truth. The necessities of the practical world have developed great bodies of science with which the investigators in pure science are more or less unacquainted and are unable to take part in, either in the way of investigation or teaching, on account of the natural limitations of time, opportunity and taste. The term "practical" better described the engineering and technical sciences and the term "applied" should be discontinued in this connection. The practical sciences are taught in the engineering schools and are applied by the engineer in his work. The teachers of practical science should keep in touch with the requirements of engineers and manufacturers and not develop merely into laboratory investigators following their own lines of thought, indifferent to where these may lead. This is right and proper in the region of pure science, but those engaged in practical science must deny themselves the pleasures of unrestricted freedom. They cannot afford to soar too long in the clouds but must return again and again to earth. They must never forget that their only reason for being is the assistance they give as educators or investigators to the actual workers in the industrial fields. It is essential for the success of their work that they should be officially independent of the teachers in pure science in the university organization. They should have experience in engineering work, not for the purpose of teaching it, for there is little engineering which can be profitably taught in a school, but in order that they may be able to properly direct their true work, the teaching and investigation of practical science.

The engineer is not simply an applier of the sciences. He comes into contact with men as well as with things. He should understand the principles underlying commerce and finance, company organization, cost keeping and accounts. A financial statement ought not to be a mystery to him nor a railway report past understanding. He should have, at least, as clear a conception of the meaning of a contract as the lawyer who drafted it. He should be able to write a report in clear and expressive English. The engineering schools are beginning to understand that these subjects are not altogether above and beyond them, nor yet beneath them. It is true that an expert business man cannot be trained in a school; no more can an expert engineer. Business science, however, can be taught just as successfully as chemistry or physics. Business men are said to have a prejudice against academic training in business. Engineers once had a similar prejudice against engineering schools. With a better understanding of their field on the part of the schools will come a better appreciation on the part of the business man. The schools should devote their energies to the teaching of principles. The teaching of practical methods should be chiefly for the purpose of making the connection between theory and practice, thus clarifying and impressing the principles on the student's mind.

One of the most difficult subjects in the curriculum is English. It should not be taught as are French and German for the purpose of giving the student access to its literature, engineering or otherwise. Students can, as a rule, get the information they want from English books without the aid of a professor of English. The object in teaching English in the engineering school should not be to give the student a grasp of the principles underlying the formation of words and sentences. It should be assumed that his high school training in grammar is sufficient for this purpose. The instruction most necessary under present conditions is training in the use of the language. However, there may be a better way. There does not seem to be any good reason why the course of instruction in English in this country should not be turned end for end. Why should not the secondary school teach the boy to use his mother tongue and the university teach grammar?

One of the dangers to be avoided in the academic course of the engineer is over-specialization. It should be remembered that the graduate does not always find work in the branch to which he has devoted his four years of academic life. If his course, therefore, has not included a reasonable number of subjects more or less common to all branches of engineering he will have good cause of complaint against the educational authorities. A properly educated graduate ought to be able by his own reading to adapt himself to any situation wherein he may be placed. A broad education is the best preparation for specialization in after life.

The academic requirements for young men entering the profession would be better determined by the discussions of practising engineers than of any other body of men, and yet they seem to have little or nothing to say on the subject. There seems to be something in the work of the engineer which suppresses talk, even useful talk. This is very well in a way but may be carried too far. Engineers ought not to hide their light under a bushel and expect the world to reward them for their silent work's sake. The world is too busy a man to study engineering and would perhaps take more interest in engineers if they were to take the trouble to explain things. However, this disability is probably on the decrease owing to the influence of the engineering schools; and engineers are not as silent as they once were. They show signs of awakening and will not long be content to act simply as advisers or scientific hired men, indifferent to the big world as long as they get their pay. The engineer of the future will force his ideas of engineering education on the public and force them more effectively than his predecessors of the past and present.

The engineer should have a thorough knowledge of the materials with which he has to deal. The laboratory investigations of the chemist, the physicist and the biologist have added greatly to the store of knowledge at his disposal. Laboratory results, however, often require modification in as much as the artificial conditions surrounding them may differ essentially from the conditions of practical work. Thus it is not sufficient to accept materials of construction simply because they have passed the specified short time tests. The engineer should know in addition as much as possible of the history of his materials, their sources, methods of manufacture, modes of growth, etc.; without this knowledge the rapid examinations in the laboratory and testing room may altogether fail in their purpose of excluding unsuitable materials. Similarly in construction, it is not sufficient to examine the completed work and see that it complies with certain specified final conditions. It is necessary to watch the whole process of manufacture and construction from the beginning to the end. In other words, no short time tests or inspection will relieve the engineer from the necessity of knowing the whole history of his materials and construction. It is this fact which has forced on the profession what one may call standardized materials and methods of construction developed from experience. New materials and new processes are wisely looked upon with distrust and can achieve success only after a long period of trial. The life of a structure or machine is not only shortened by imperfections of material and workmanship and the corroding action of the elements, but by being subjected to heavier service than was anticipated in the original design. The engineer must therefore combine the functions of the prophet and the actuary and decide to what present expense it is worth while going in view of future contingencies.

There is more or less doubt in the minds of engineers as to the degree to which details of workmanship, manufacture, modes of construction, materials, etc., should be covered in their specifications. The only answer is "that depends." Where in these respects standardization has taken place and the engineer knows that the results are good, the task of specifying is comparatively simple. Much may be left to the contractor and manufacturer. Where, on the contrary, customary methods and materials are not appropriate to the work, the specifications of the engineer must be given in greater detail. Thus between the extremes of simply specifying the results desired, leaving methods and materials to those who do the work, and specifying how everything is to be done and the actual materials to be used there is wide latitude, and the medium to be adopted in every case depends largely on the general conditions of available manufacturing and contracting skill and capacity. Whatever may be the degree of detail to which he may carry his specifications the engineer cannot be relieved from the obligation of being well acquainted with the current practice of manufacturing and contracting firms, and with the materials with which he has to deal whether they be materials of construction or obstruction. The young graduate can have no better position in which to gain experience than that of contractor's engineer.

It would be well for specifications to cover not only the work to be performed by the contractor but also the data and assumptions underlying the engineer's project. While not absolutely necessary for the prosecution of the work, such information would be useful to the profession and for future reference, not to speak of its effect upon the engineer himself in increasing his sense of responsibility. The different classes of drawings referred to in the contract should be carefully defined in the specifications, otherwise ambiguities and uncertainties in interpretation will arise. Drawings may be looked upon as a species of shorthand invented to save words, time and expense, and the engineer should be an expert in reading drawings, and in writing them in such a way as to convey his exact meaning. Correct drawings and correct English both imply a competent knowledge of the subject of which they are the expression.

The engineer should know the cost of the work done under his supervision, not merely the cost to the proprietor, for that goes without saying, but also as far as possible the cost to the contractor. Not only should he keep in touch with the labor market, but he should take an interest in the physical and social welfare of the men under his charge. They should look upon

Convocation Hall, University of Toronto, where the joint meeting of the Canadian Society of Civil Engineers and Engineering Society was held him as a friend and not as an impersonal being concerned only in the results of their work. As between the contractor and the proprietor he must occupy the position of an impartial judge and not that of an advocate. The more thoroughly he knows his work the better able will he be to do his duty in this respect, and to retain the confidence of both parties. His knowledge of law and business should be sufficient to enable him to act harmoniously with those in charge of the legal and commercial interests connected with his work. In fine he must be a many-sided man, thoroughly acquainted with his own side of the work and able to cooperate with all sorts and conditions of men.

Engineers are naturally divided into classes according to the special nature of their work. For the purpose of mutual improvement in their specialties, these classes form societies, of which the main features are the reading of papers, the interchange of ideas and the extension of personal acquaintance. While these societies do a vast amount of good within their own spheres they are not capable of dealing with the question of the improvement of the engineering profession as a whole. The Canadian Society of Civil Engineers was formed in 1887 with this object. The charter reads: "The Canadian Society of Civil Engineers having for its objects and purposes to facilitate the acquirement and interchange of professional knowledge among its members and more particularly to promote the acquisition of that species of knowledge which has special reference to the profession of civil engineering, and further to encourage investigation in connection with all branches and departments of knowledge connected with the profession," etc.

The second by-law reads: "The term Civil Engineer as used in this Society shall mean all who are or have been, engaged in the designing or constructing of railways, canals, harbors, lighthouses, bridges, roads, river improvements or other hydraulic works, sanitary, electrical, mining, mechanical or military works or in the study and practice of navigation by water or air, or in the directing of the great sources of power in nature for the use and convenience of man."

It must be confessed after an existence of twenty-one years that the Canadian Society has not succeeded in gaining recognition by the various classes of engineers in the country as the representative and authoritative engineering society. Even in England the term "civil engineering" has not gained full recognition as embracing all branches of the profession.

The "New English Dictionary" edited by Sir James Murray and recognized as one of the greatest authorities on the language, gives among others the following definitions of the word engineer:

"2b. One who designs and constructs military works for attack or defence.

"3. One whose profession is the designing and constructing of works of public utility such as bridges, roads, canals, railways, harbors, drainage works, gas and waterworks, etc. From 18th century also civil engineer, not in Johnson 1775 or Todd 1818. The former has only the military sense to which the latter adds 'a maker of engines,' citing Bullokar.

"In the early quotations the persons referred to were probably by profession military engineers though the works mentioned were of a 'civil' character. Since 2b. has ceased to be a prominent sense of engineer the term 'civil engineer' has lost its original antithetic force but it continues to be the ordinary designation of the profession to which it was first applied, distinguishing it from that of mechanical engineer. Other phraseological combinations, as electric, gas, mining, railway, telegraph engineers are used to designate those who devote themselves to special departments of engineering.

"1792 Smeaton, Reports (1797) I Pref. 7. The first meeting of this new institution, the Society of Civil Engineers, was held on the 15th of April, 1793.

"1793 Edystone L. Introd. 8 'my profession of a civil engineer.'"

As Smeaton died in 1792, the dates 1797 and 1793 are probably the dates of publication of the reports. According to Sir Alexander Binnie, the first society of civil engineers in England was formed in London about the year 1760 by engineers who were in attendance at the Session of Parliament.

It seems, therefore, that the term "civil engineer" in England dates from about 1760 and that in the opinion of the editor of the New English Dictionary, who may be assumed to represent the public, it applies at present to engineers having to do with works of public utility such as those mentioned, but it is to be distinguished from the term mechanical engineer.

The same tendency to restriction of the term "civil engineer" exists in Canada and the United States not only among the public but in the profession as well. In all the great engineering schools this tendency is reflected.

The question now arises, is it worth while to expend further energy in resisting what appears to be a natural tendency? The only reason for the introduction of the term "civil" was that the word "engineer" had previously been monopolized by those engaged in military works; now that this distinction has lost its importance, would it not be better to drop the term "civil" as applied to the whole profession and confine it to the special applications justified by modern custom?

The profession as a whole should be represented in Canada by a single authoritative body somewhat after the pattern of the Medical Council or the Benchers of the Law Society in Ontario, to which should be entrusted the subjects of engineering education, qualifications for professional standing, professional ethics, etc., in short all questions of general professional interest. It is only by the hearty co-operation of the various classes of engineers that such a movement could succeed. The Canadian Society of Engineers with its Council would thus exercise functions which are necessary for the strengthening of the profession in its relations with the public, and which lie outside the province of the special engineering societies.

As a rule the engineer does not come immediately into contact with the public. At the same time there are questions of public interest in which he, in common with the chemist, the metallurgist, the biologist, the medical practitioner, the forester and others, is regarded as an authority. The public expects the engineer to aid by his advice in the improvement of transportation, the prevention of railway accidents, the abatement of smoke, the preservation and improvement of public health, transmission of power, the irrigation of arid lands, the economical management and conservation of forests and mines, the improvement of agricultural soils, the conservation of river flow, etc., etc. Such questions are matters of municipal and governmental policy and cannot be properly controlled by money-making corporations or individuals. Before a move can be made in these matters a strong body of enlightened public opinion must be formed, and who should be better qualified for the task of stimulating and guiding this public opinion than the engineer? If he is too busy or too backward to undertake this duty of his own accord, what about the editor of the engineering newspaper? The latter is never hampered by modesty and should write not only for his subscribers but for the public as well. He need not fear that his work will be lost; the lay press will print his good articles and give him due credit for them.

Mr. Carnegie is reported to have made the statement that at the present rate of consumption, the supply of iron ore (presumably the more important and richer ores) of the United States would be exhausted in forty years and the supply in England within seven years. He based this opinion on the best expert evidence he could obtain. If this statement be correct, what a prospect does it not open for the vast iron resources of Canada, and yet at the same time what a warning does it not convey to the government which controls these resources! In the United States the total production of pig iron up to the present is 350,000,000 tons of which over one-half has been made within the last ten years. The production of the world in 1907 was 61,000,000 tons, of which the United States are to be credited with 26,000,000, Germany with 13,000,000, Great Britain with 10,000,000 and other countries with 11,000,000. Canada produced 600,000 tons less than one per cent. of the total. In the United States the acid Bessemer process seems to have reached its maximum output and in the future will rapidly diminish in importance owing to the increasing scarcity of the requisite ores and its inability to use scrap. It is being rapidly superseded by the basic open hearth process, which can utilize ores containing a larger percentage of phosphorus and also all kinds of scrap.

The future of electric processes in iron and steel production in Canada will depend more upon the cost of hydro-electric power than on any other factor. Closely connected with the conservation of the iron and timber resources of America is the great Portland cement industry, which has sprung into importance within the last twenty years. The Canadian production in 1907 amounted to 2,400,000 barrels, the United States production to 49,000,000 barrels. Concrete and ferro concrete will replace steel and wood in construction in ever increasing quantities. As in the case of the electrometallurgy of iron, the cost of hydro-electric power is a large item in the manufacture of cement.

The conservation and regulation of river-flow for water power alone, to say nothing of transportation and irrigation, is a necessity for the future industries of the country. The regularity and volume of river-flow in its turn is dependent upon the preservation of forest growth, especially in the mountainous and upland regions. Forest conservation in fact is one of the fundamental conditions of future prosperity. And so one might go on, and enumerate one after the other, various sources of wealth and well-being now extravagantly exploited which demand for their wise development the knowledge and skill of the engineer. It is to be hoped that the conferences initiated by President Roosevelt to consider the conservation of natural resources will bear fruit in pointing the way to practical solutions of these national problems. Canada has already made a good beginning both in collecting information regarding our resources and in passing legislation.

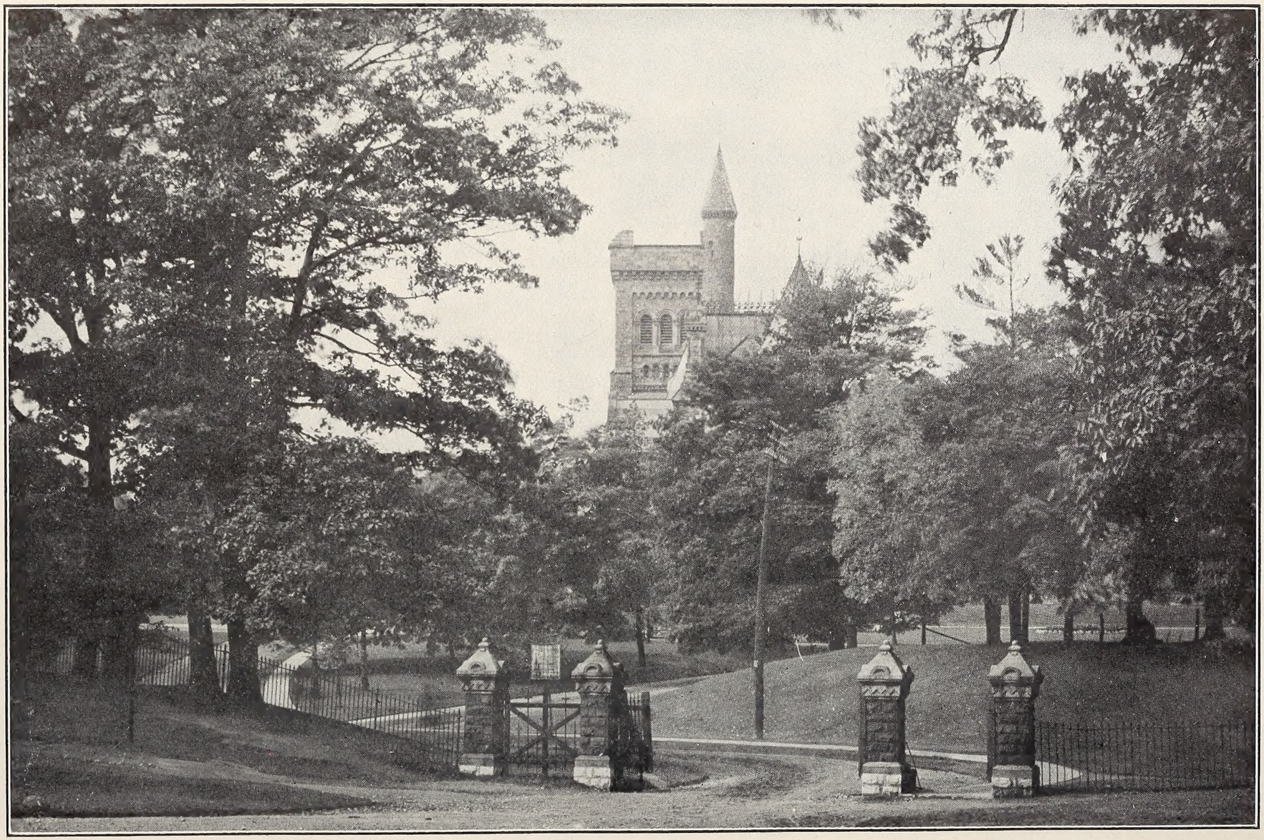
One of the most striking illustrations of modern economic tendencies is the increase which has taken place in the voltage of power transmission lines. Within the last twenty-five years the practicable voltage has been increased from 1,000 to 110,000 volts, thus immensely extending the possible area of distribution from the hydro-electric power plant.

In the machine shop, complex machine tools, largely the inventions of the mechanic, high speed tool steels, electric motor drives and high class organization have immensely increased the output and decreased unit costs. The steam turbine, the improved hydraulic turbine, electric lighting, electric traction, the gas engine, the great ocean and lake freighters, the monster liners and that concentrated essence of power, the modern battleship, have all come within the present generation and we cannot predict what changes in the application of power and machinery will take place before it passes away. It would not be surprising if the automobile were to displace electric transportation in cities and be replaced for purposes of pleasure by the aeroplane and the dirigible balloon. In the future, electric transportation may be confined to underground tunnels in the cities and largely replace steam power on railway lines through the country. Evidently the end of the work of the engineer is not yet at hand. The inventions of the present day, under the stimulus of science and the ever-increasing complexity of life, crowd so closely upon us that it is impossible to form a just estimate of their relative values. That must be left to the judgment of posterity looking backward through the long perspective of the years.

One of the first duties of a country is to work up within its own limits its raw materials into the forms in which they are to be finally used by individual consumers. Only in so far as this end is successfully accomplished will the manufacturing population of a country be increased and the cost of transportation of its products to a foreign country, in comparison with their value, be diminished. One effect of over-production or decreased profits is to stimulate invention for the purpose of reducing the cost of production and transportation. As a rule the first effect is to throw labor out of employment, but this is no argument against invention. Wages will fall in any case owing to the failing market for the product, and can be maintained only by the discovery of new markets. The decrease of cost due to labor-saving inventions leads to the extension of the markets without which production must be checked and labor seek new fields, or be reduced to a lower standard of living. Thus a country depends for material prosperity as much upon the brains of its scientific men, inventors and engineers as upon its natural resources. Money spent upon unproductive enterprises means waste of labor and the stoppage before long of the wheels of industry. Capital knows no country; it ever flows to the land of promise; let it be our endeavor to make Canada no mere land of promise but a land of fulfilment as well. Fortunate in possessing vast agricultural resources without which no nation can be self-sustaining, Canada can afford to take time in developing its mines. The mines are our treasure houses, which once emptied, can never again be filled—while the scattered gold, silver, copper and iron that remain in the country may to some extent be recovered after having fulfilled their first uses, the coal, oil, and gas once used are gone forever.

The preservation of our fisheries and forests demands our first attention. Their cultivation must begin and their mining must cease, if we are not to lose them altogether. Nor need the engineer fear that under such a policy his opportunities would be deferred or his field narrowed. The conservation of our resources will introduce many new problems, will stimulate research and invention, cheapen production, open up new markets and enable the country to sustain a much larger and more permanent population than we have any right to expect from a continuance of our present ill regulated and short-sighted practice of extravagant consumption and waste.

In conclusion I have to thank the members of the Society for the honor they conferred upon me a year ago in electing me to the highest office within their gift, an honor altogether undeserved on the score of previous service. I have also to thank my colleagues of the outgoing council for the kindly assistance which I have in many ways received from them in the performance of my special duties. I am sure that they join me in wishing the new council an increased measure of success in promoting the interests of the Society.



Eastern Entrance University of Toronto
University College in Background